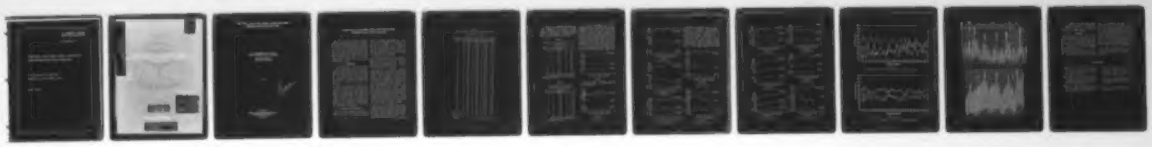
AD-A036 231 SCHOOL OF AVIATION MEDICINE RANDOLPH AFB TEX F/G 6/16
HUMAN WHOLE SALIVA VOLUME, SODIUM, AND POTASSIUM UNDER PROLONGE--ETC(U)
APR 59 I L SHANNON, J R PRIGMORE

UNCLASSIFIED SAM-59-63 NL

I OF I
AD-A
036231



END
DATE
FILMED
4-5-77
NTIS

HUMAN WHOLE SALIVA VOLUME, SODIUM, AND POTASSIUM UNDER PROLONGED MASTICATORY STIMULATION

SCHOOL OF AVIATION MEDICINE
RANDOLPH AIR FORCE BASE, TEXAS

APRIL 1959

HUMAN WHOLE SALIVA VOLUME, SODIUM AND POTASSIUM UNDER PROLONGED MASTICATORY STIMULATION

Air University
SCHOOL OF AVIATION MEDICINE, USAF
RANDOLPH AFB, TEXAS

HUMAN WHOLE SALIVA VOLUME, SODIUM, AND POTASSIUM UNDER PROLONGED MASTICATORY STIMULATION

IRA L. SHANNON, Major, USAF (DC)*
JOHN R. PRIGMORE, Captain, USAF (MSC)†

*Dental Sciences Division
†Department of Pathology

59-63

Air University
SCHOOL OF AVIATION MEDICINE, USAF
RANDOLPH AFB, TEXAS
April 1959

7758-23

HUMAN WHOLE SALIVA VOLUME, SODIUM, AND POTASSIUM UNDER PROLONGED MASTICATORY STIMULATION

This experiment was designed to determine the effect of prolonged continuous stimulation on salivary volume and concentrations of sodium and potassium. These baseline data were necessary since some of our experimental situations now cover extended time periods. Sodium and potassium were of particular interest since previous publications from this laboratory have dealt extensively with these ions (1-4) and since an effort is being made to employ the concentrations of these cations as indices of adrenocortical status.

PROCEDURE

Twelve healthy males in the 20- to 38-year age group participated. Under the stimulation of three large (size 32) pure gum rubber bands, five-minute whole saliva samples were collected from each individual over a three-hour time period. Thus, 36 samples were obtained from each subject. Accumulated saliva was collected in graduated centrifuge tubes and the rate of flow was determined directly therefrom.

Levels for sodium and potassium were determined on a Beckman DU flame spectrophotometer equipped with a photomultiplier and spectral energy recording adapter, and burning a hydrogen-oxygen flame. Each saliva sample was refrigerated immediately after collection and was diluted for analysis invariably within one hour of collection. The preparation of stock standards and the dilution factors for both samples and standards have been previously described (4). All determinations were carried out in duplicate.

RESULTS AND DISCUSSION

The time means, standard deviations, and coefficients of variation for each variable are shown in table I. The standard deviations used in computing coefficients were determined from the variation attributable to subject by time interaction in the analysis of variance. This variation is an estimate of the variability of the subjects in time, as well as an estimate of the basic error, including laboratory error, for the experiment. The great bulk of the variation is due to the variability of the subjects in time.

No significant differences were found in the mean volume levels in time. Significant differences ($P < .01$) were found in the time means for sodium, potassium, and the Na/K ratio. Na and Na/K were found to decrease with time while the K mean increased.

For each of the 12 subjects, correlation coefficients were computed for volume and sodium (table II) and volume and potassium (table III). These results are similar to those obtained when correlation coefficients were computed for each subject in a recent diurnal trend study (5). Although all of the coefficients for volume and sodium were positive, 3 of the 12 coefficients were not significant. For volume and potassium, the coefficients ranged from fairly large positive values to fairly large negative values, 6 of the 12 coefficients not being significant when tested against zero. Thus, under the conditions of the present study, it appeared that, although a relatively constant positive relationship was found for volume and sodium, the relationships of volume and the two salivary constituents studied were quite different from one subject to another.

Figure 1 depicts graphically the means for volume, sodium, and potassium over the three-hour time period. Volume did not change significantly but sodium decreased and potassium increased with the passage of time. However, the findings for the individual subjects (figs. 2-13) differed widely from this group mean result. Within individuals there was no pattern to

Received for publication on 13 January 1959.

TABLE I

Salivary volume, sodium, potassium, and Na/K means

(12 observations in each mean)

Sample No.	Volume (ml./5 min.)	Na (mEq./liter)	K (mEq./liter)	Na/K
1	8.06	13.98	20.77	.68
2	8.22	12.17	21.02	.59
3	7.88	11.57	21.34	.56
4	7.70	11.60	21.75	.55
5	7.66	11.33	21.82	.54
6	7.87	11.87	21.72	.57
7	7.42	11.62	21.95	.55
8	7.57	11.02	22.18	.52
9	8.26	11.64	22.31	.55
10	8.09	11.25	22.25	.52
11	8.12	11.65	22.20	.55
12	8.44	11.24	22.50	.52
13	7.45	10.74	22.43	.50
14	7.72	10.42	22.49	.49
15	8.51	11.56	22.57	.53
16	8.00	11.14	22.54	.51
17	8.12	11.32	22.89	.51
18	8.79	11.38	23.22	.51
19	8.12	10.99	22.98	.50
20	7.94	10.20	23.36	.45
21	7.93	10.64	23.51	.46
22	7.62	11.24	23.58	.49
23	7.80	9.98	23.59	.43
24	7.46	10.42	23.27	.46
25	7.83	9.84	23.14	.43
26	7.35	9.38	22.94	.42
27	7.50	8.93	23.14	.39
28	7.47	9.56	23.26	.43
29	7.77	9.22	23.31	.40
30	7.53	8.77	23.28	.38
31	7.60	8.97	23.49	.39
32	8.01	9.86	23.34	.43
33	7.22	9.44	23.78	.41
34	7.32	9.52	23.82	.41
35	7.68	9.54	23.68	.41
36	8.02	9.16	23.79	.39
Over-all mean	7.83	10.64	22.76	.48
S. D.	1.11	1.97	1.01	.07
Coefficient of variation	14.2%	18.5%	4.4%	

the levels for the variables and there was a great difference between consecutive samples within individuals. This disparity between group mean tendencies and individual findings points out the danger of conclusions based entirely on findings for groups of subjects.

TABLE II

The influence of flow rate on sodium concentration within individuals

Subject No.	Correlation coefficient (R)	P*
1	+ .41	< .05
2	+ .19	> .05
3	+ .69	< .01
4	+ .16	> .05
5	+ .73	< .01
6	+ .81	< .01
7	+ .08	> .05
8	+ .77	< .01
9	+ .59	< .01
10	+ .70	< .01
11	+ .43	< .01
12	+ .36	< .05

*The probability given for R represents the chance of obtaining that large an R or larger if the population correlation coefficient were zero.

TABLE III

The influence of flow rate on potassium concentration within individuals

Subject No.	Correlation coefficient (R)	P*
1	- .21	> .05
2	+ .09	> .05
3	- .59	< .01
4	- .01	> .05
5	- .63	< .01
6	- .69	< .01
7	+ .04	> .05
8	+ .71	< .01
9	+ .76	< .01
10	- .40	< .05
11	+ .29	> .05
12	- .19	> .05

*The probability given for each R represents the chance of obtaining that large an R or larger if the population correlation coefficient were zero.

In an effort to investigate this lack of uniformity between consecutive samples within individuals, effort was directed toward the secretion of the parotid glands. This decision was based upon the relative histologic simplicity of the parotid and the ease with which this gland may be sampled. When consecutive small samples of parotid fluid were collected from an individual, it was found that sodium, potassium, and chloride values showed no uniformity between consecutive samples. Figures 14 and 15 show the sample-to-sample variation in sodium and potassium, respectively, when 40, consecutive 1.0 ml. samples were

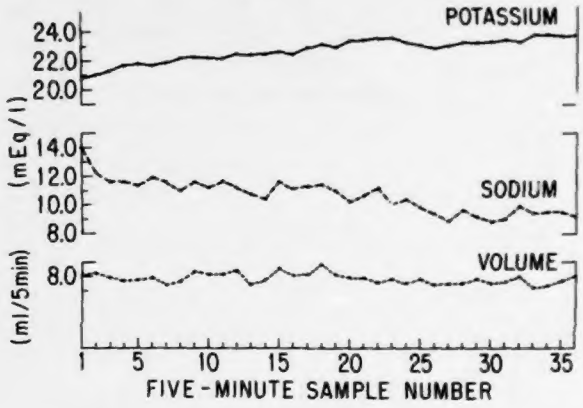


FIGURE 1

For the entire group of 12 subjects, mean levels of sodium, potassium, and volume during three hours' stimulation.

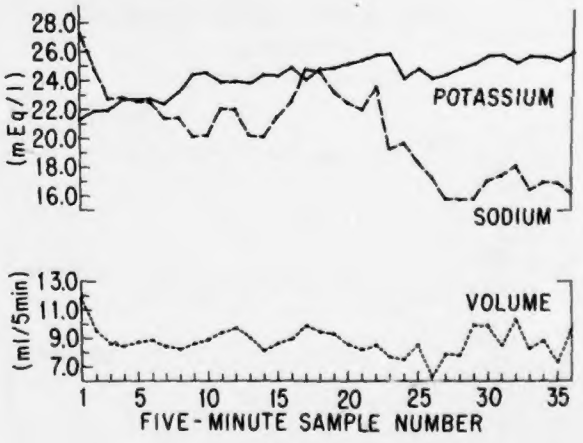


FIGURE 2

Values for subject 1.

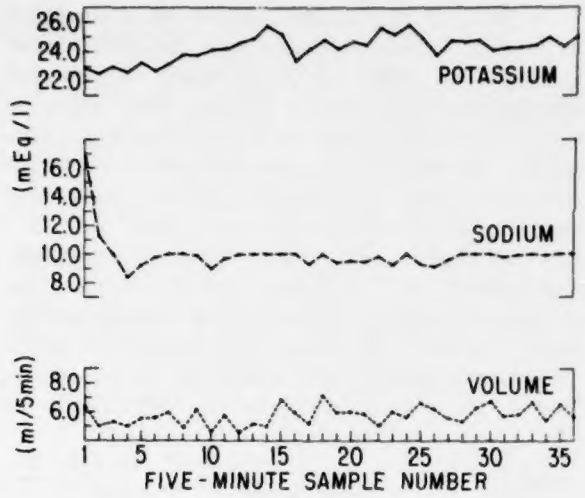


FIGURE 3

Values for subject 2.

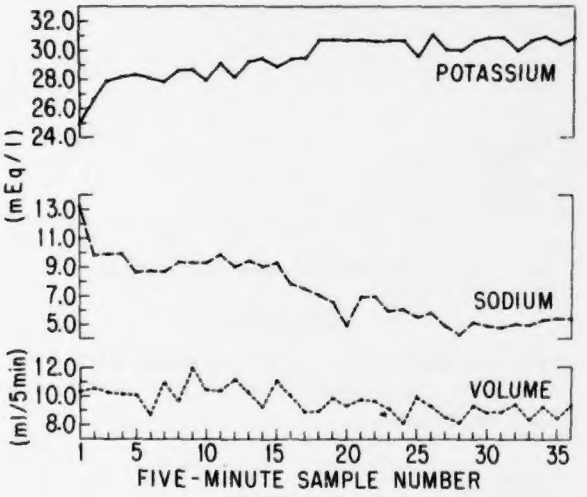


FIGURE 4

Values for subject 3.

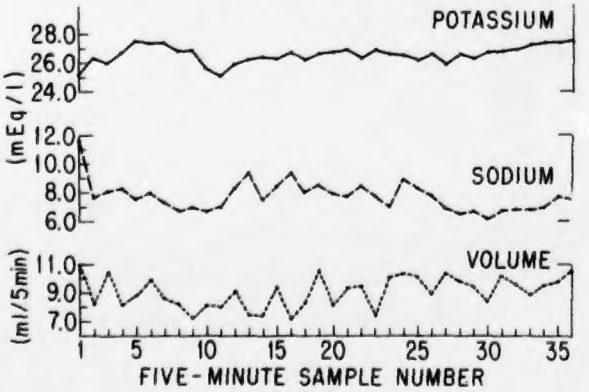


FIGURE 5

Values for subject 4.

collected from 3 subjects. Figures 16 and 17 are Technicon Autoanalyzer (6) recorder tapes showing the variation in chloride levels in 40 consecutive 0.5 ml. parotid samples. Evidently these salivary electrolytes are not elaborated through the parotid gland in a constant fashion and it thus becomes very important that the sampling procedures produce the volume necessary to encompass a uniform number of these response-fatigue-like patterns. That is to say, a large sample of saliva might

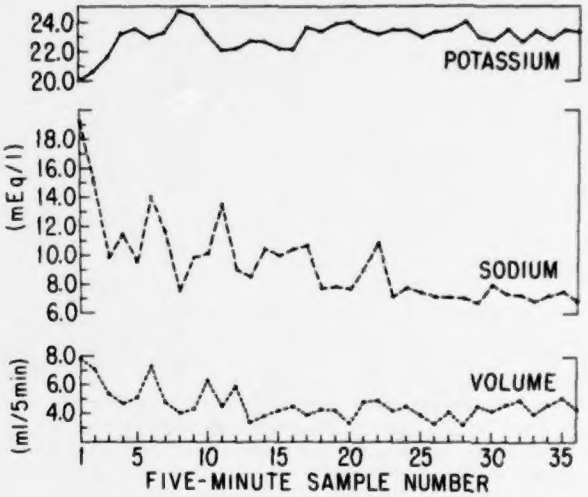


FIGURE 6

Values for subject 5.

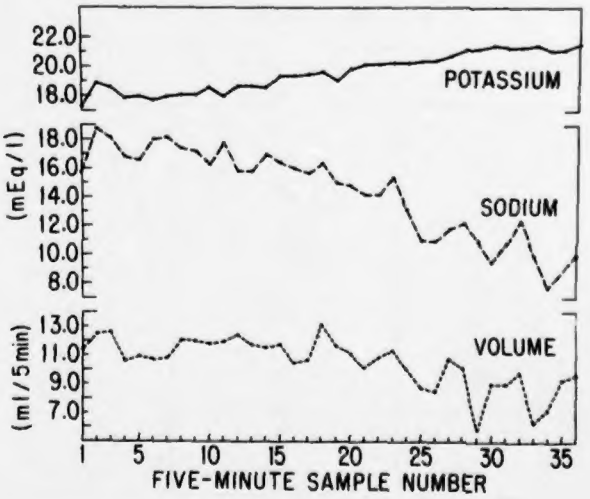


FIGURE 7

Values for subject 6.

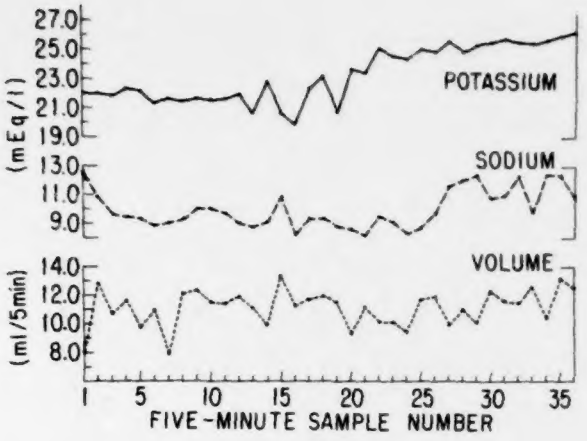


FIGURE 8
Values for subject 7.

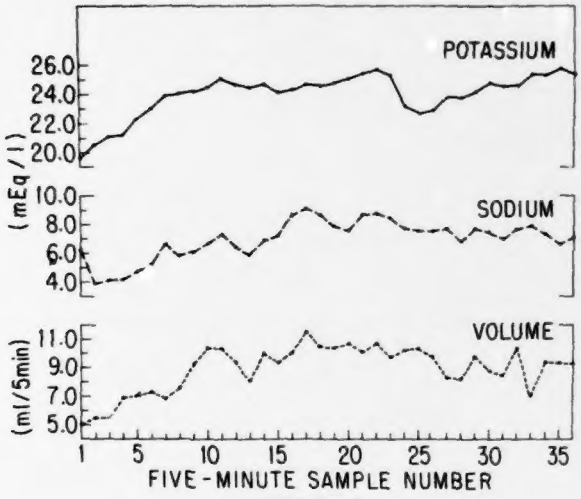


FIGURE 9
Values for subject 8.

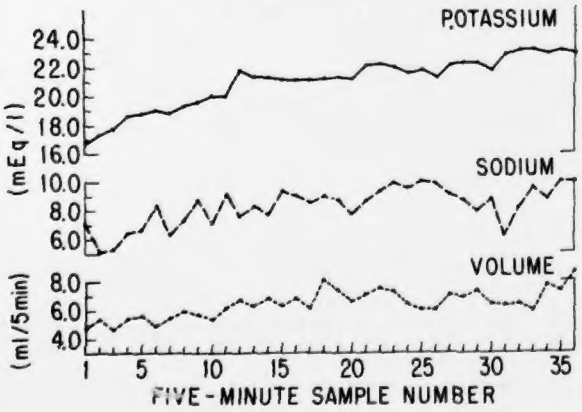


FIGURE 10
Values for subject 9.

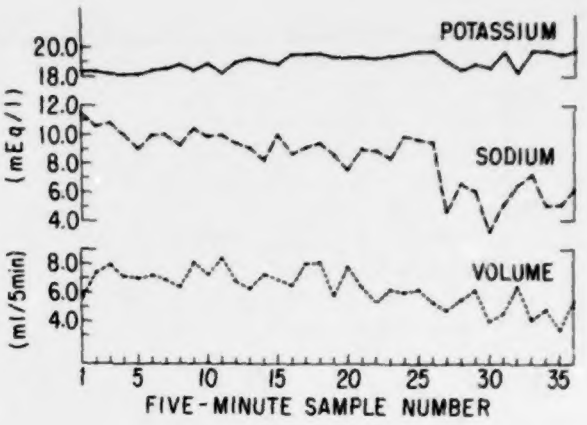


FIGURE 11
Values for subject 10.

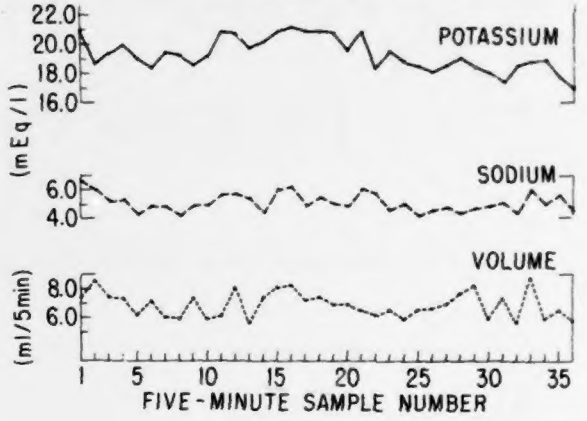


FIGURE 12
Values for subject 11.

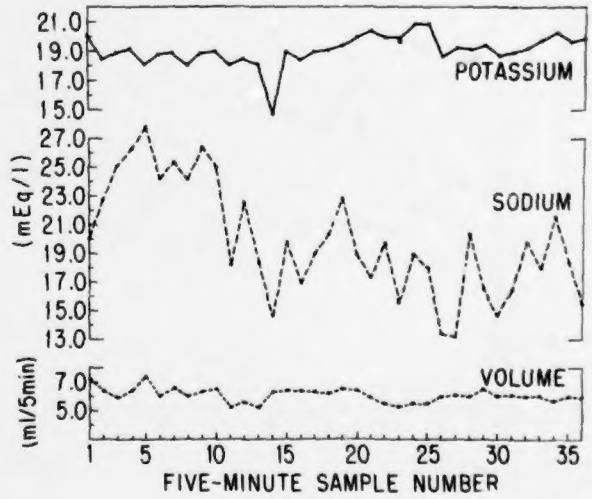


FIGURE 13
Values for subject 12.

59-63

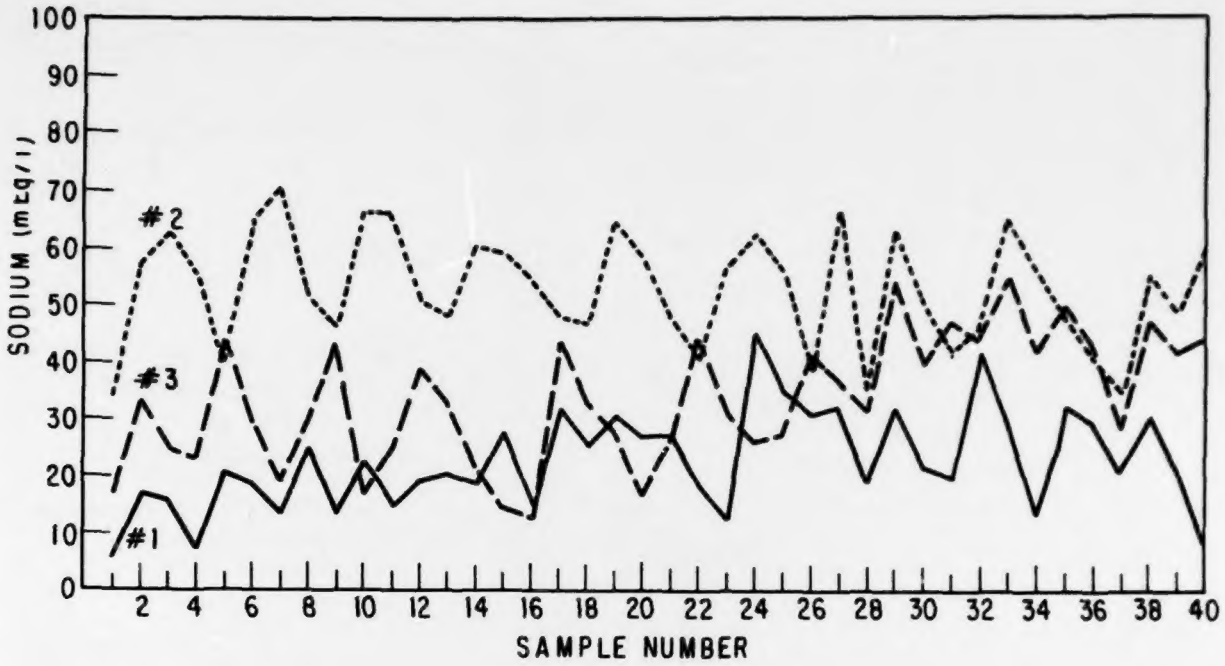


FIGURE 14

Sodium values for 40 consecutive 1.0 ml. samples of parotid fluid in 3 subjects.

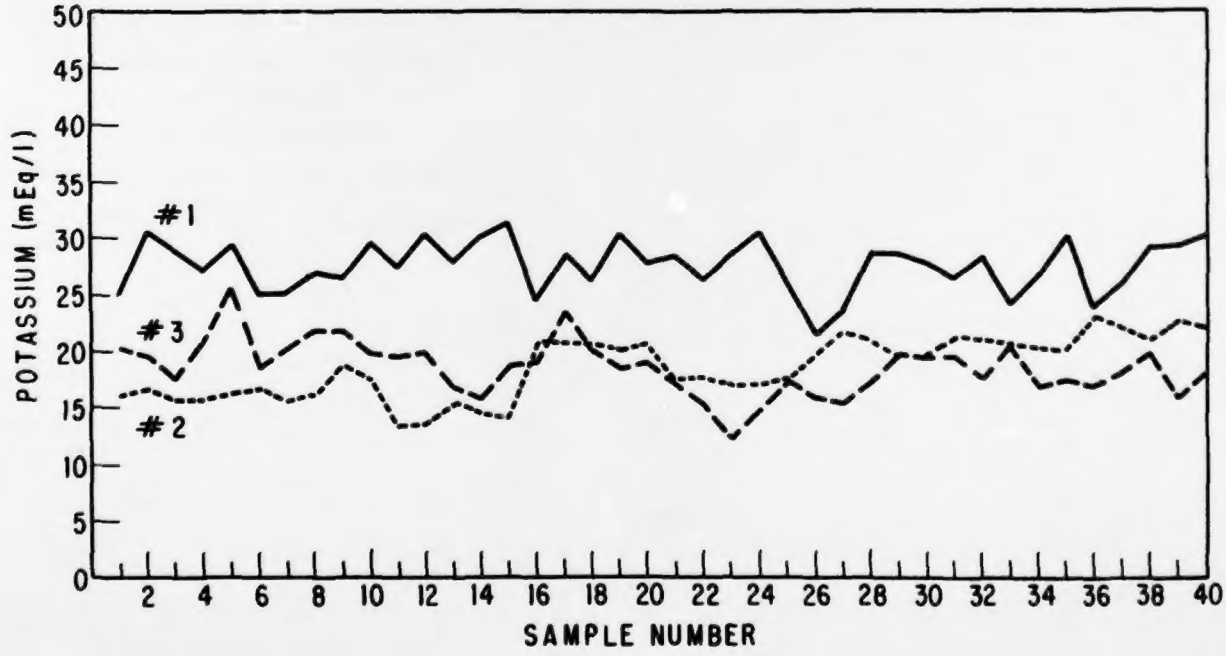


FIGURE 15

Potassium values for 40 consecutive 1.0 ml. samples of parotid fluid in 3 subjects.

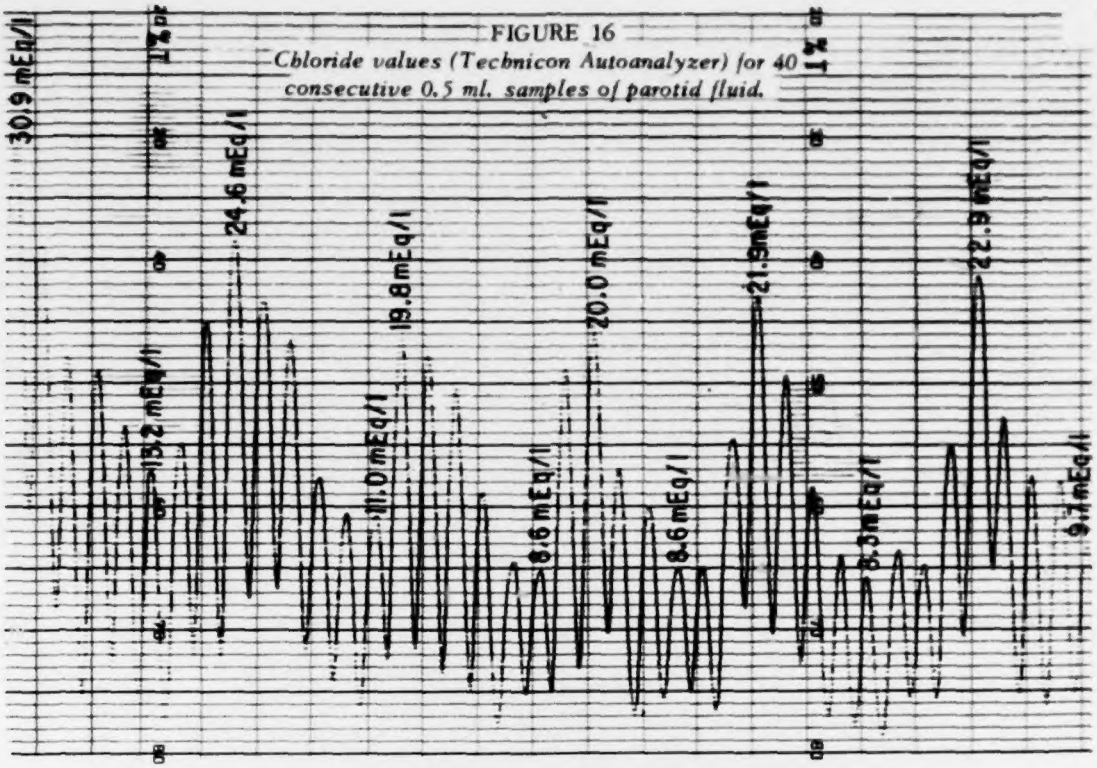


FIGURE 16

Chloride values (Technicon Autoanalyzer) for 40 consecutive 0.5 ml. samples of parotid fluid.

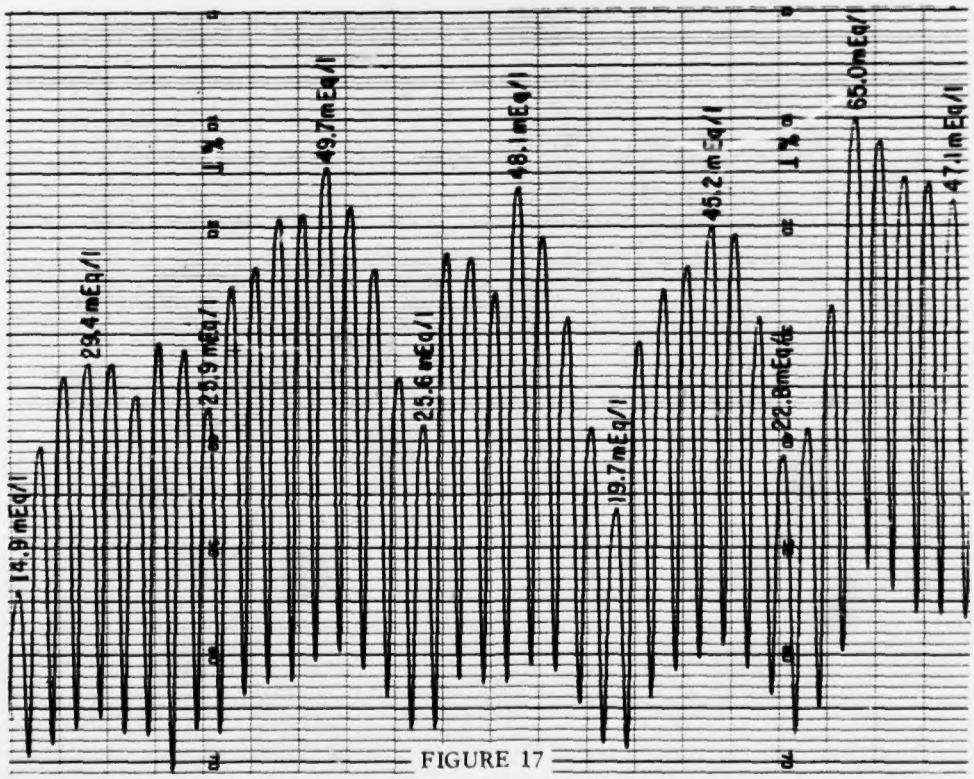


FIGURE 17

Chloride values (Technicon Autoanalyzer) for 40 consecutive 0.5 ml. samples of parotid fluid.

much more properly be considered a conglomerate of many small samples of varying electrolyte composition since there is no homogeneity in this regard when the large sample is collected in many small segments.

SUMMARY

Twelve healthy male subjects were stimulated with three rubber bands over a three-hour period and 36 consecutive five-minute whole saliva samples were collected. Flame photometric determinations of sodium and potassium were carried out, the ratio of these two variables, Na/K, was calculated and statistical analyses were performed on the data.

When group means were analyzed, it was found that volume levels did not change with time, that sodium and Na/K decreased with time, and that K increased with time. For sodium and potassium, individuals did not follow the pattern of the group mean findings but, rather, marked differences were found not only between individuals but also between consecutive samples from the same subject.

By collecting and analyzing 40 consecutive small samples from individuals, it was shown that the electrolytes, sodium, potassium, and chloride, are not elaborated through the parotid gland in a constant fashion but that, rather, there is a great variation in concentration of these variables between consecutive samples.

The authors express appreciation to Miss Muriel Stahnke for the statistical analysis and to Airmen J. F. McAnear, E. D. Dinger, L. R. Crawford, L. D. Tripp, R. R. Hogue, and I. L. Wilson for technical assistance.

REFERENCES

1. Shannon, Ira L. Sodium and potassium levels of human whole stimulated saliva collected at a low rate of flow from subjects in a select age grouping. School of Aviation Medicine, USAF, Report 57-80, June 1957.
2. Shannon, Ira L. Sodium and potassium levels of human whole stimulated saliva collected at a moderate rate of flow from subjects in a select age grouping. School of Aviation Medicine, USAF, Report 57-99, May 1957.
3. Shannon, Ira L. Sodium and potassium levels of human whole saliva collected without exogenous stimulation. School of Aviation Medicine, USAF, Report 58-49, Feb. 1958.
4. Shannon, Ira L. Whole saliva volume, sodium, potassium, and chloride-day to day comparisons under identical and diverse forms of stimulation. School of Aviation Medicine, USAF, Report 58-83, Apr. 1958.
5. Shannon, Ira L. A search for diurnal characteristics in human whole stimulated saliva. School of Aviation Medicine, USAF, Report 59-46. (In press)
6. Skeggs, L. T. An automatic method for colorimetric analysis. Am. J. Clin. Path. 28:311 (1957).